Intel® RAID Controller SASMF8I Hardware User's Guide

Intel Order Number: E33625-003

DISCLAIMER

Preface

This is the primary reference and user's guide for the Intel® RAID Controller SASMF8I, which can be used for SAS and SATA II disk drives. It contains installation instructions and specifications.

For details on how to configure the storage adapters, and for an overview of the software drivers, see the *Intel® IT/IR RAID Software User's Guide* on the Resource CD.

Audience

This document assumes that you have some familiarity with storage disk controllers, RAID technology, and related support devices. The people who benefit from this book are:

- Engineers who are designing an Intel® RAID Controller SASMF8I for a system.
- Anyone installing an Intel® RAID Controller SASMF8I in a software RAID system.

Organization

This document includes the following chapters and appendixes:

- Chapter 1 provides a general overview of the Intel® RAID Controller SASMF8I.
- Chapter 2 describes the procedures for installing the Intel® RAID Controller SASMF8I.
- Chapter 3 provides the characteristics and technical specifications for the Intel® RAID Controller SASMF8I.
- Appendix A lists and explains the terms and abbreviations used in this manual.

Related Publication

The *Intel® IT/IR RAID Software User's Guide* on the Resource CD that is included with the RAID controller.

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1 Overview

This chapter provides a general overview of the Intel® RAID Controller SASMF8I. It consists of the following sections:

- Summary of SAS RAID Controller Features
- Benefits of Serial-Attached SCSI (SAS)

The Intel® RAID Controller SASMF8I is a high-performance PCI Express* SAS RAID controller. It provides reliability, high performance, and fault-tolerant disk subsystem management. This is an ideal RAID solution for the internal storage needs of mid to low-end servers and workstations for use by workgroups and departmental-sized organizations or individuals. The Intel® RAID Controller SASMF8I offers a cost-effective way to implement RAID in a server for internal storage.

The SAS controller allows you to use SATA II and SAS hard disk drives in the same system, so you can take advantage of the benefits of each type of drive. The controller supports up to eight devices including expander devices. See the *ANSI SAS Standard Specification, Version 1.0* for more information about the use of expanders.

As the second generation PCI Express* storage adapter, the Intel® RAID Controller SASMF8I addresses the growing demand for increased data throughput and scalability requirements across mid to low-end servers and workstations. Simplified cabling between drives is an additional benefit.

Summary of SAS RAID Controller Features

Note: *In this document, the term low-profile refers to the height, not the length, of a PCI add-in card.*

The Intel® RAID Controller SASMF8I is a low-profile SAS RAID adapter with:

- An LSI 1068E SAS (including SATA) controller.
- Eight independent internal ports provided via two SFF8087 connectors.
- Support for both enterprise-class SAS devices and enterprise-class SATA II drives.
- Support for up to 8 SAS or SATA II drives and 40 logical drives.
- PCI Express* connector that fits into a x4 PCI Express slot capable of 2.5 Gbps per lane over PCI Express* x1, or x4.
- 3.0 Gbps point-to-point transfer rate.
- Both a standard and a low-profile bracket.

The SAS controller supports the *ANSI Serial-attached SCSI (SAS) Standard, Version 1.0*. In addition, the controller supports the Serial ATA (SATA) protocol defined by the *Serial ATA Specification, Version 1.0a*. The SAS controller is a versatile controller that supports both the SAS and SATA interfaces and provides the backbone of both server and high-end workstation environments.

Protocols supported include:

- Serial SCSI Protocol (SSP): Communication with other SAS devices.
- SATA II Protocol: Communication with other SATA II devices.
- Serial Management Protocol (SMP): Topology management information sharing with expanders.
- Serial Tunneling Protocol (STP) support for SATA II through expander interfaces.

Usability

- Smaller, thinner cabling with serial point-to-point 3.0 Gbps data transfer rates.
- Allows mixed connections to SAS or SATA II targets.
- Support for non-disk devices and mixed capacity drives.
- Support for software RAID levels 0, 1, 5, and 10.
- Global hot spare with auto rebuild if an array drive fails.
- Fixed RAID stripe size of 64 KB.
- Advanced array configuration and management utilities that provide:
  — Drive migration.
  — Drive roaming.
- An upgradeable Flash ROM interface.
- Allows for staggered spin-up, hot plug, and lower power consumption.
- User specified rebuild rate (% of system resources to use from 0-100%).

  Warning: *Exceeding 50% rate may cause operating system errors caused by waiting for controller access.*

- Background operating mode can be set for rebuilds, consistency checks,and initialization (auto restarting consistency check on redundant volumes).

Redundancy and Error Handling

- Enclosure management support, including LEDs.
- Activity and fault indicators per drive, port selector (dual-port drives).
- Drive coercion (auto resizing to match existing disks).
- Auto-detection of failed drives with transparent rebuild. Disk activity (I/O to the drive) must be present for a missing drive to be marked as failed.

- Auto-resume of initialization or rebuild on reboot (the auto rebuild feature must be enabled before virtual disk creation).

- Smart initialization automatically checks consistency of virtual disks if there are five or more disks in a RAID 5 array, which optimizes performance by enabling read-modify-write mode. RAID 5 arrays of only three or overdrives use peer read mode.

- Smart Technology predicts failures of drives and electronic components.

- Commands are retried at least four times.

- Firmware provides best effort to recognize an error and recover from it if possible.

- Failures are logged from controller and drive firmware, SMART monitor, and SAF-TE controller.

- Failures are logged in Intel® RAID Web Console 2 or CIM, and can be viewed from LEDs.

- Multiple cache options provide choice of speed and redundancy:

  — Disk Write Cache: The data written / (done) signal is returned when data is written to the drive or only to the drive's cache.

    ✧ On (default): Write back mode enabled. Faster, because it does not wait for the disk, but data will be lost if power is lost.

    ✧ Off: Write-through mode enabled. Slower, but ensures data is on the disk.

  — Read Ahead: Predicts the next read will be sequential and buffers this data into the drive's cache.

    ✧ On: Read Ahead mode enabled. Faster in data sequential read mode but slower in data random read mode.

    ✧ Off: Non-Read Ahead mode enabled. Always reads from the drive after determining the exact location of each read.

- Redundancy through:

  — Configuration stored in non-volatile RAM and on the drives (COD).

  — Hot-swap support.

SAS and SATA Features

- Provides eight independent PHYs, each supporting 3.0 Gbps and 1.5 Gbps SAS and SATA data transfers.

- Scalable interface that supports up to eight direct-attached SAS/SATA devices or eight logical devices.

- Transfers data using SCSI information units.

- Supports SSP to enable communication with other SAS devices.

- Supports SMP to communicate topology management information.

- Supports single PHY or wide ports consisting of two, three, or four PHYs within a single quad port.

- Allows addressing of multiple SATA targets through an expander if using SATA 2.0-compliant hard disk drives.
- Allows multiple initiators to address a single target (in a fail-over configuration) through an expander.

Operating System Support

The Intel® RAID Controller SASMF8I supports major operating systems, including:

- Microsoft Windows Server 2008*, Microsoft Windows Server 2003*, and Microsoft Windows XP*
- Red Hat* Enterprise Linux 4.0 and 5.0
- SuSe* Linux Enterprise Server 9 and 10

Note: *The operating systems supported by this controller may not be supported by your server board. See the tested operating system list for your server board at http://support.intel.com/support/motherboards/server/. See also the Tested Hardware and Operating System List for the Intel® RAID Controller SASMF8I to make sure the RAID controller supports your operating system.*

Benefits of Serial-Attached SCSI (SAS)

SAS is a serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. SAS is a convergence of the advantages of SATA, SCSI, and FC, and is the future mainstay of the enterprise and high-end workstation storage markets. SAS offers a higher bandwidth per pin than parallel SCSI, and improves signal and data integrity.

The SAS interface uses the proven SCSI command set to ensure reliable data transfers, while providing the connectivity and flexibility of point-to-point serial data transfers. The serial transmission of SCSI commands eliminates clock skew challenges. The SAS interface provides improved performance, simplified cabling, smaller connectors, lower pin count, and lower power requirements when compared to parallel SCSI.

SAS controllers leverage a common electrical and physical connection interface that is compatible with Serial ATA technology. The SAS and SATA protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 40-wire ATA cable. The SAS/SATA connector and cable are easier to manipulate, allow connections to smaller devices, and do not inhibit airflow. The point-to-point SATA architecture eliminates inherent difficulties created by the legacy ATA master-slave architecture, while maintaining compatibility with existing ATA firmware.

2 Intel® RAID Controller SASMF8I Hardware Installation

This chapter describes the procedures used to install the Intel® RAID Controller SASMF8I with internal connectors.

Requirements

The following items are required to install a Intel® RAID Controller SASMF8I:

- An Intel® RAID Controller SASMF8I.
- A host system with an available x4 bi-directional PCI Express* slot.
- The *Resource CD*, which contains drivers and documentation.
- The cables provided with the RAID controller.
- SAS or SATA II hard disk drives.

Note: *Intel Corporation strongly recommends using an uninterruptible power supply (UPS).*

Installing the RAID Controller

To install the RAID Controller, follow these steps:

1. Power off the computer, all drives, enclosures, and system components. Remove the power cord from the computer.

2. Remove the chassis cover and access the PCI Express add-in card slots. For instructions, see your server chassis documentation.

3. Align the controller's connector with a x4 PCI Express* slot on the server board.

4. Press down gently but firmly to ensure that the card is properly seated in the slot, as shown in Figure 1. Secure the bracket to the computer chassis.

Bracket Screw

Press Here

Press Here

PCI Express* Slot (3.3V)

32-bit Slots (3.3V)

64-bit Slot (3.3V)

Edge of Main Board

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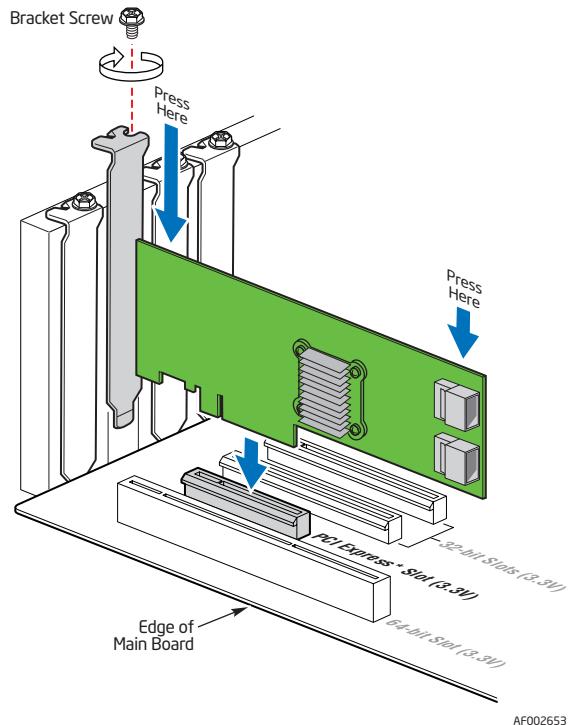
Figure 1. Inserting the Intel® RAID Controller SASMF8I into a PCI Express* Slot

5. Connect the SAS/SATA cables from the backplane (or hard drives) to the RAID Controller. Make sure the cables are properly connected to the controller.


Ports 0-3
Ports 4-7
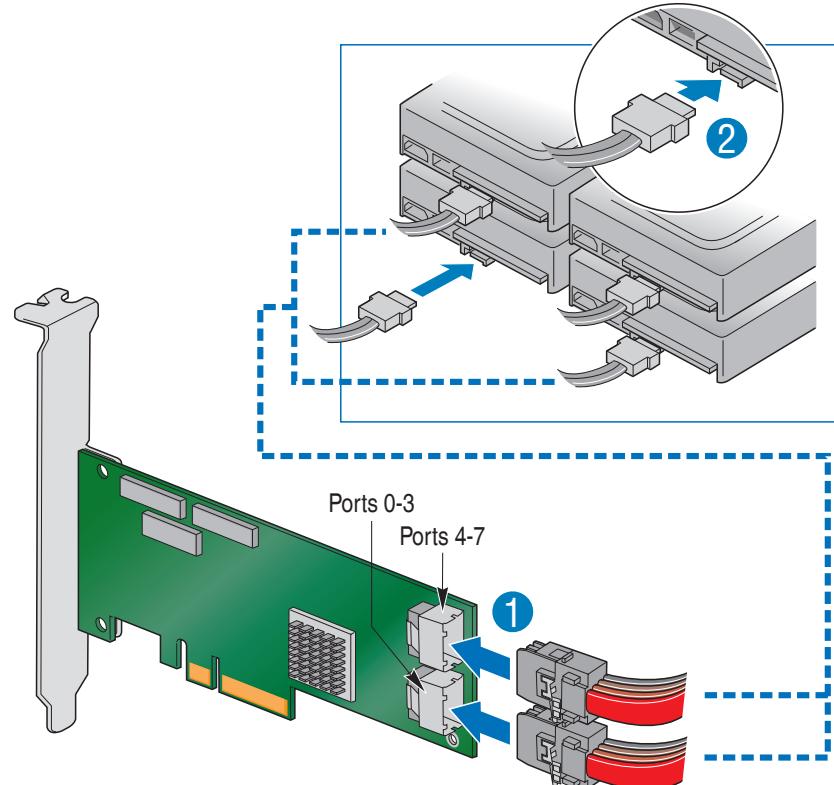
Figure 2. Attaching cables to the Intel® RAID Controller SASMF8I

Note: *System throughput problems can occur if the SAS cables that come with the RAID controller are not used. To minimize the potential for problems:*

— Use cables no longer than ten meters for SAS and one meter for SATA. It is better to use the shortest possible cables. The cable length should be reduced by about one foot (.33 meters) if using a backplane.

— You may connect one device per SATA/SAS cable either as a device or as an expander.

— Route SAS cables carefully.

— Use only "straight" SAS cables, not "cross-over" SAS cables.

6. Replace components you needed to remove to access the PCI Express add-in card slot. For instructions, see your server chassis documentation.

7. Reinstall the chassis cover and reconnect the power cord(s). For instructions, see your server chassis documentation.

8. Reconnect any peripheral items you needed to disconnect.

9. Turn the power on to the server and hard drives. As the server powers up, listen to be sure that the SAS and SATA devices are powered up before or at the same time as the computer boots.

10. Watch the boot process until you see a BIOS message to inform you of the key combination to press to enter the Intel® Embedded Server RAID Technology II Configuration Utility. A message similar to the following appears:

```
Press <CTRL> + <E> to run the Intel® Embedded Server RAID Technology
II Configuration Utility.
```

This message times out after several seconds. If you miss it, you will pass the option to get into the Intel® Embedded Server RAID Technology II Configuration Utility.

The firmware takes several seconds to initialize and then displays the Intel® RAID Controller SASMF8I number and firmware version. The numbering of the controllers follows the PCI slot scanning order used by the server board.

Connecting the Cables

This section describes the cables used on the SAS controller and provides instructions for connecting SAS and SATA hard disk drives to the SAS RAID controller.

Note: *Use only "straight" SAS cables, not "cross-over" SAS cables.*

The cable supplied with the Intel® RAID Controller SASMF8I is for SATA drives or a SAS backplane connection.

A SATA connector consists of a signal connector and a power connector. The SAS connector adds a bridge (primary physical link) between the signal connector and the power connector. This means SAS backplane connectors can accept either drive type, but SATA backplane connectors can ONLY accept SATA drives. Figure 3 shows these connectors.
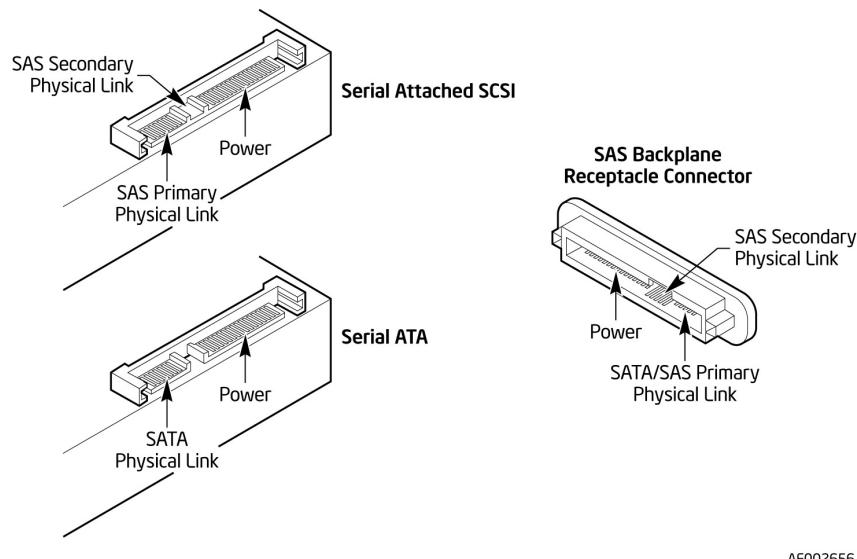
Figure 3. SAS and SATA Plugs and SAS Backplane Connector

Configuring the Storage Adapter

After installing the Intel® RAID Controller SASMF8I, you must configure the storage adapter and install the operating system driver. The Intel® *IT/IR RAID Intel® IT/IR RAID Software User's Guide* instructs you on the configuration options and how to set them on your Intel® RAID Controller SASMF8I, and provides detailed installation instructions for operating system drivers.

Replacing a Controller

To replace a failed controller, follow these steps:

1. Power off the computer, all drives, enclosures, and system components. Remove the power cord.

2. Remove the chassis cover and access the PCI Express* add-in card slots. For instructions, see your server documentation.

3. Disconnect the cable(s) from the RAID controller.

4. Remove the failed controller from the system.

5. Insert the replacement controller into the system. For instructions, see "Installing the RAID Controller".

3 Intel® RAID Controller SASMF8I Characteristics

This chapter describes the characteristics of the Intel® RAID Controller SASMF8I. Figure 4 displays the connectors and headers on the controller and Table 1 describes them.

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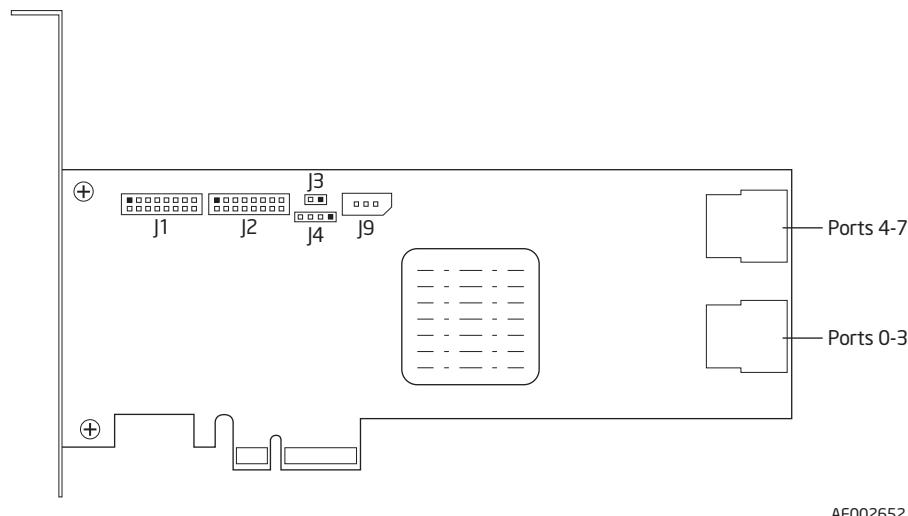
Figure 4. Card Layout.

Table 1. Jumper Descriptions

Jumper	Description	Type	Comments
J1	Drive Fault LED header	8x2 header	LED signal to control front panel LEDs to reflect the faulty drive.
J2	Port activity LED header	8 x 2 header	LED signal for activity per port.
J4	Universal Asynchronous Receiver/ Transmitter (UART)	4-pin connector	For factory and debug use.
J6	Internal SAS/SATA port connector, ports 4-7	SFF8087	Connection to SAS/SATA devices.

Table 1. Jumper Descriptions

Jumper	Description	Type	Comments
J7	Internal SAS/SATA port connector, ports 0-3	SFF8087	Connection to SAS/SATA devices.
J9	Keyed I^{2}C connector	3-pin connector	Out-of-band enclosure management (SES2)

Technical Specifications

The design and implementation of the Intel® RAID Controller SASMF8I minimizes electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. See the appendices for regulatory marks and certifications.

Table 2 lists the specifications for the Intel® RAID Controller SASMF8I.

Table 2. Specifications

Specification	Intel® RAID Controller SASMF8I
Operating Voltage	+3.3 V, +12 V
Card Size	Low-profile MD2 PCI Express* adapter card size (6.600 inches by 2.713 inches)
Array Interface to Host	PCI Express* Rev 1.0A, x4 lane width 2.5 Gbps
SAS Bus Speed	3 GBps per port, point-to-point
SAS Controller	One LSI SAS 1068 controller
SAS / SATA Ports	2x4 internal ports. Supports 8 SAS/SATA devices using expanders, and 40 virtual disks.
Firmware	2 MB in reflashable flash ROM
Compatible Devices	• Mixed capacity, mixed SATA II and SAS in different enclosures • Non-disk devices, including expanders.
Cabling	• Small, thin cables that do not restrict airflow • Shared connectors for multiple drive types.
Redundant Configuration	Config on disk (COD) stores RAID configuration.
Enclosure Management	I^{2}C out-of-band, SES2 in-band, SAF-TE (LEDs)

Array Performance Features

Table 3 lists the Intel® RAID Controller SASMF8I array performance features.

Table 3. Array Performance Features

Specification	Intel® RAID Controller SASMF8I
PCI Express* Host Data Transfer Rate	2.5 Gigabit/s per lane
Drive Data Transfer Rate	3 Gigabit/s per lane
Maximum Scatter/Gathers	26 elements
Maximum Size of I/O Requests	6.4 Mbytes in 64 Kbyte stripes
Maximum Queue Tags per Drive	As many as the drive can accept
Stripe Sizes	64 Kbyte
Maximum Number of Concurrent Commands	255
Support for Multiple Initiators	Yes
Flexibility	Drive migration
Background Services	Rebuild, consistency check, and initialization
Cache Options	Write-back or write-through, read ahead, and non-read ahead

Fault Tolerance

Table 4 lists the Intel® RAID Controller SASMF8I fault tolerance features.

Table 4. Fault Tolerance Features

Specification	Intel® RAID Controller SASMF8I
Self Monitoring Analysis and Reporting Technology (SMART) support	Detects up to 70% of all predictable disk drive failures and monitors the internal performance of all motors, heads, and drive electronics.
Drive Replacement	• Auto detection of hard drive failure • Hot-plug, hot-swap • User set rebuild rate

Table 4. Fault Tolerance Features

Specification	Intel® RAID Controller SASMF8I
Drive Rebuild Using Hot Spares	• Automatic at drive failure • Auto-resume of initialization or rebuild on reboot
Error Checking and Indication	• Parity generation and checking, automatic consistency checking • Activity and fault LEDs
Power Conservation	Staggered spin-up, lower power requirements.

Electrical Characteristics

This section provides the power requirements for the Intel® RAID Controller SASMF8I. Table 5 lists the maximum power requirements.

Table 5. Electrical Characteristics

PCI / PCI Express* / Express +12 V	PCI / +5.0 V	PCI / PCI Express / Express +3.3 V	PCI PRSNT1# / 2# Power	Operating Range Temperature
N/A	N/A	1 A	3.2 W	0° C to 45° C

Thermal and Atmospheric Characteristics

The thermal and atmospheric characteristics are:

- Relative humidity range: 5% to 90% non-condensing
- Maximum dew point temperature: 32°C
- Airflow must be at least 200 linear feet per minute (SFPM) to avoid operating above the maximum ambient temperature.

The storage and transit environment conditions are:

- Temperature range from -30°C to 80°C (dry bulb).
- Relative humidity range: 5% to 90% non-condensing

Safety Characteristics

The Intel® RAID Controller SASMF8I meets or exceeds the requirements of UL flammability rating 94 V0. Each bare board is also marked with the supplier name or trademark, type, and UL flammability rating. For the boards installed in a PCI Express* bus slot, all voltages are lower than the SELV 42.4 V limit.

The design and implementation minimizes electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The adapter carries the CE mark, C-tick mark, FCC self-certification logo, Canadian compliance statement, Korean MIC, Taiwan BSMI, and Japan VCCI. The adapter meets the requirements of CISPR Class B. This adapter matches the description in CCSA C22.2, No. 60950-1, UL60950-1 First Edition listed accessory, UL filenumber E257743.

A   Glossary of Terms and Abbreviations

BIOS
Basic Input/Output System. Software that provides basic read/write capability. Usually kept as firmware (ROM based). The system BIOS on a server board is used to boot and control the system. The BIOS on your host adapter acts as an extension of the system BIOS.

Configuration
The way a computer is setup; the combined hardware components (computer, monitor, keyboard, and peripheral devices) that make up a computer system, and the software settings that allow the hardware components to communicate with each other.

Device Driver
A program that allows a microprocessor (through the operating system) to direct the operation of a peripheral device.

Domain Validation
A software procedure in which a host queries a device to determine its ability to communicate at the negotiated data rate.

EEPROM
Electronically Erasable Programmable Read-Only Memory. A memory chip typically used to store configuration information. It provides stable storage for long periods without electricity and can be reprogrammed. See NVRAM.

External SAS Device
A SAS device installed outside the computer cabinet. These devices are connected together using specific types of shielded cables.

Host
The computer system in which a storage adapter is installed. It uses the storage adapter to transfer information to and from devices attached to the SCSI bus.

Host Adapter Board (HAB)
A circuit board or integrated circuit that provides a device connection to the computer system.

Internal SAS Device
A SAS device installed inside the computer cabinet. These devices are connected together using an unshielded ribbon cable.

Main Memory
The part of a computer's memory which is directly accessible by the CPU (usually synonymous with RAM).

NVRAM
Non-volatile Random Access Memory. An EEPROM (Electronically Erasable Read-Only Memory chip) used to store configuration information. See EEPROM.

Peripheral Devices
A piece of hardware (such as a video monitor, disk drive, printer, or CD-ROM) used with a computer and under the computer's control. SCSI peripherals are controlled through a SAS Intel® RAID Controller SASMF8I.

SAS   Serial-attached SCSI. A serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. The SAS interface provides improved performance, simplified cabling, smaller connections, lower pin count, and lower power requirements when compared to parallel SCSI. SAS controllers leverage a common electrical and physical connection interface that is compatible with Serial ATA. The SAS controllers support the ANSI *Serial Attached SCSI standard, version 1.0.* In addition, the controller supports the Serial ATA (SATA) protocol defined by the *Serial ATA specification, version 1.0a*. Each port on the SAS RAID controller supports SAS and SATA devices.

SAS Device   Any device that conforms to the SAS standard and is attached to the SAS bus by a SAS cable. This includes SAS storage adapters (host adapters) and SAS peripherals.